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Promotion and Application of Weekly GLP-1 Receptor Agonist Preparations in the Treatment of Type 2 Diabetes Patients

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Abstract: *Objective:* To explore the promotion and application of weekly GLP-1 receptor agonist in the treatment of type 2 diabetes mellitus. *Methods:* From December 2021 to June 2023, 100 patients with type 2 diabetes mellitus admitted to our hospital were selected and randomly divided into a control group and an experimental group, with 50 patients in each group. The control group received conventional hypoglycemic drug treatment, while the experimental group received weekly GLP-1 receptor agonist treatment. The compliance during the observation period, blood glucose control, number of hospitalizations, and patient satisfaction were compared between the two groups. *Results:* The compliance during the observation period in the experimental group (96.00%) was higher than that in the control group (76.00%), with a statistically significant difference ($p = 0.003$). After treatment, the levels of fasting plasma glucose (FPG), 2-hour postprandial blood glucose (2hPG), and glycosylated hemoglobin (HbA1c) in the experimental group were (6.11 ± 0.84) mmol/L, (8.75 ± 1.18) mmol/L, and (7.01 ± 0.16)%, respectively, which were all lower than those in the control group [(8.13 ± 1.24) mmol/L, (11.02 ± 1.76) mmol/L, and (7.64 ± 0.76)%], with statistically significant differences (all $p = 0.001$). After treatment, the abdominal circumference, body mass, and annual hospitalization days in the experimental group were (96.01 ± 3.84) cm, (23.02 ± 1.11) kg/m^2, and (11.36 ± 2.25) days, respectively, which were all lower than those in the control group [(102.45 ± 3.41) cm, (24.54 ± 1.31) kg/m^2, and (14.31 ± 5.27) days]. The drug discontinuation rate in the experimental group (4.00%) was lower than that in the control group (24.00%), with statistically significant differences (all $p < 0.05$). The overall satisfaction rate in the experimental group (96.00%) was higher than that in the control group (74.00%), with a statistically significant difference ($p = 0.002$). *Conclusion:* Weekly formulations of GLP-1 receptor agonists can effectively and safely lower blood glucose levels, reduce medication frequency, and offer advantages such as a low risk of hypoglycemia, weight reduction, and decreased hospitalization rates, making them worthy of widespread application.

Keywords: GLP-1 receptor agonist; Weekly formulation; Diabetes; Type 2

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1. Introduction

As a common clinical condition, according to statistics from the International Diabetes Federation, the global number of diabetes patients reached 151 million in 2000. By November 2010, this number had exceeded 300 million, with an additional 300 million people at high risk of developing diabetes [1,2]. Diabetes, a prevalent metabolic disorder, often presents with clinical manifestations such as frequent thirst, increased appetite, and weight loss. Furthermore, the condition can lead to severe complications affecting multiple organs, including the heart, kidneys, and brain, posing a significant threat to patients' health. The key factors in the onset and progression of type 2 diabetes are insulin resistance and the decline and pathology of pancreatic islet function, specifically characterized by excessive secretion of glucagon by islet α cells and impaired insulin secretion by islet β cells, resulting in an imbalance between insulin and glucagon levels [3]. GLP-1 is an incretin hormone produced by intestinal endocrine cells after eating. It interacts with islet β cells to promote insulin secretion while reducing glucagon secretion from islet α cells, delaying gastric emptying, centrally inhibiting appetite, and protecting cardiovascular and β cells. Additionally, disturbances in glucose and lipid metabolism in the body, triggered or exacerbated by high glucose toxicity, significantly increase the risk of diabetic arteriosclerosis. Therefore, blood glucose control remains the top priority in current diabetes treatment [4,5]. Based on this, this study employed weekly GLP-1 receptor agonist preparations to treat patients with type 2 diabetes mellitus and analyzed the potential for widespread application of weekly GLP-1 receptor agonist preparations in the treatment of type 2 diabetes mellitus.

2. Materials and methods

2.1. Materials

From December 2021 to June 2023, 100 patients with type 2 diabetes mellitus admitted to our hospital were selected and randomly divided into a control group and an experimental group, with 50 patients in each group. In the control group, there were 26 males and 24 females, with an average age of (57.51 ± 3.86) years and an average disease duration of (7.44 ± 2.01) years, with a standard deviation of 2.01 years. In the experimental group, there were 27 males and 23 females, with an average age of (57.74 ± 3.67) years and an average disease $p > 0.05$).

2.1.1. Inclusion criteria

(1) Adult patients with type 2 diabetes mellitus under the age of 70;
(2) Disease duration of more than 2 years;
(3) Body mass index greater than 24 kg/m^2;
(4) Waist circumference: greater than 85cm for males and greater than 80cm for females;
(5) eGFR greater than 15 $mL/min/1.73m^2$;
(6) No history or family history of medullary thyroid carcinoma, no history of type 2 multiple endocrine neoplasia syndrome, and no history of pancreatitis.

2.1.2. Exclusion criteria

(1) Patients with other significant organ failure diseases;
(2) Patients with severe malignant tumors;
(3) Patients with drug allergies;
(4) Patients with abnormalities in the central nervous system;
(5) Patients with incomplete clinical case data.

2.2. Treatment methods

Treatment method for the control group: Conventional oral hypoglycemic drugs and insulin were administered, with specific dosages determined based on the actual amount required to achieve target blood glucose levels.

Treatment method for the experimental group: Dulaglutide 1.5 mg weekly or semaglutide 0.25–1.0 mg weekly (based on the actual amount required to achieve target blood glucose levels in patients) was administered. Clinical efficacy was evaluated at 1 month, 3 months, 6 months, and 1 year from the observation start date in patients. This evaluation included assessing blood glucose control, the number of medication discontinuations, body mass index, abdominal circumference, the number of hospitalizations, patient satisfaction. During the treatment period, standardized management of patients' medication behaviors was implemented, dietary intervention measures were carried out, and reasonably healthy diets were formulated to ensure balanced nutrient intake for patients. Simultaneously, patients were guided to engage in moderate exercise to optimize bodily circulation and metabolism. Through continuous blood glucose monitoring and data analysis, treatment effects were precisely evaluated, and targeted adjustments to the treatment plan were made based on actual conditions.

2.3. Indicator detection

2.3.1. Observation period compliance

Based on the Morisky Medication Adherence Scale, the maximum score is 8, which is categorized into three levels: excellent, good, and poor [6]. Specifically, an excellent score is defined as greater than 7 and less than or equal to 8; a good score ranges from 6 to 7; and a poor score is defined as greater than or equal to 0 and less than 6. The formula for calculating treatment adherence is (number of excellent cases + number of good cases) / total number of cases × 100%.

2.3.2. Blood glucose control

Venous blood sampling was performed to measure fasting plasma glucose (FPG), 2-hour postprandial plasma glucose (2hPG), and glycated hemoglobin (HbA1c) levels.

2.3.3. Comparison of recovery and annual hospitalization days

Medical staff observed and recorded the abdominal circumference, body weight, annual hospitalization days, and medication discontinuation rate of patients in both groups before and after treatment.

2.3.4. Medication discontinuation rate

The researcher recorded and counted the number of cases in both groups where the original treatment plan (conventional hypoglycemic drugs/insulin in the control group, GLP-1 receptor agonist weekly preparation in the experimental group) was discontinued for any reason (including but not limited to adverse reactions, poor efficacy, patient's personal preference, loss to follow-up, etc.) throughout the observation period (from the start of observation to the end of the 1-year follow-up).

2.3.5. Comparison of satisfaction level

An investigation and analysis were conducted on the satisfaction levels of two groups of patients regarding two postoperative nursing approaches, utilizing a self-developed patient satisfaction survey scale from our hospital, which assessed satisfaction across three dimensions: satisfied, average, and dissatisfied. The overall satisfaction rate was calculated as (satisfied + average) / total number of cases × 100%.

2.4. Statistical analysis

Statistical analysis was performed using SPSS 26.0 software. Continuous data were presented as ($\bar{x} \pm s$), with comparisons between groups conducted using independent sample *t*-tests and within-group comparisons using paired *t*-tests. Categorical data were expressed as percentages, with comparisons between groups performed using the chi-square (χ^2) test. A *p*-value of less than 0.05 was considered statistically significant.

3. Results

3.1. Comparison of compliance during the observation period between the two groups

As shown in **Table 1**, the compliance during the observation period in the experimental group was higher than that in the control group, with a significant difference ($p < 0.05$).

Table 1. Comparison of compliance during the observation period between the two groups [n, (%)]

Group	Number of cases (n)	Excellent	Good	Poor	Observation period compliance rate
Control group	50	20 (40.00)	18 (36.00)	12 (24.00)	38 (76.00)
Experimental group	50	29 (58.00)	19 (38.00)	2 (4.00)	48 (96.00)
χ^2-value					8.306
p-value					0.003

3.2. Comparison of blood glucose levels before and after treatment between the two groups

As shown in **Table 2**, there were no significant differences in FPG, 2hPG, and HbA1c levels between the two groups before treatment ($p > 0.05$). After treatment, the experimental group exhibited a decrease in FPG, 2hPG, and HbA1c levels compared to the control group, with significant differences ($p < 0.05$).

Table 2. Comparison of blood glucose levels before and after treatment between the two groups ($\bar{x} \pm s$)

Group	Number of cases (n)	FPG (mmol/L)		2hPG (mmol/L)		HbA1c (%)	
		Pre-treatment	Post-treatment	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
Control group	50	8.34 ± 0.89	8.13 ± 1.24	11.20 ± 2.08	11.02 ± 1.76	8.03 ± 0.85	7.64 ± 0.76
Experimental group	50	8.42 ± 0.97	6.11 ± 0.84	11.23 ± 1.94	8.75 ± 1.18	8.06 ± 0.97	7.01 ± 0.16
t-value	-	0.429	9.537	0.074	7.757	0.164	12.300
p-value	-	0.668	< 0.001	0.941	< 0.001	0.869	< 0.001

3.3. Comparison of recovery and annual hospitalization days between the two groups of patients

As shown in **Table 3**, there were no significant differences in abdominal circumference, body mass, and annual hospitalization days between the two groups before treatment ($p > 0.05$). After treatment, compared with the control group, both groups exhibited decreases in abdominal circumference, body mass, and annual hospitalization days, along with a reduction in medication discontinuation rates, with significant differences observed ($p < 0.05$).

Table 3. Comparison of recovery and annual hospitalization days between the two groups of patients ($\bar{x} \pm s$)

Group	Number of cases (n)	Waist circumference (cm)		BMI (kg/m²)		Annual hospitalization days		Medication discontinuation rate
		Pre-treatment	Post-treatment	Pre-treatment	Pre-treatment	Post-treatment	Pre-treatment	
Control group	50	103.02 ± 0.84	102.45 ± 3.41	24.89 ± 2.42	12 (24.00)	102.45 ± 3.41	24.89 ± 2.42	12 (24.00)
Experimental group	50	102.97 ± 1.02	96.01 ± 3.84	24.74 ± 2.25	2 (4.00)	96.01 ± 3.84	24.74 ± 2.25	2 (4.00)
t-value	-	0.267	8.867	0.321	8.036$^{\chi^2}$	8.867	0.321	8.036$^{\chi^2}$
p-value	-	0.789	< 0.001	0.749	0.003	< 0.001	0.749	0.003

3.4. Comparison of medication discontinuation rates between the two groups of patients

As shown in **Table 4**, the medication discontinuation rate in the experimental group was significantly different from that in the control group ($P < 0.05$).

Table 4. Comparison of medication discontinuation rates between the two groups of patients [n, (%)]

Group	Number of cases (n)	Discontinued medication	Continued medication	Discontinuation rate
Control group	50	12	38	24.00%
Experimental group	50	2	48	4.00%
χ^2-value				8.036
p-value				0.003

3.5. Comparison of overall satisfaction between the two groups of patients

As shown in **Table 5**, the overall satisfaction rate in the experimental group was higher than that in the control group, with a significant difference observed ($p < 0.05$).

Table 5. Comparison of overall satisfaction between the two groups of patients [n, (%)]

Group	Number of cases (n)	Satisfied	Generally satisfied	Dissatisfied	Overall satisfaction rate
Control group	50	18 (36.00)	19 (38.00)	13 (26.00)	37 (74.00)
Experimental group	50	28 (56.00)	20 (40.00)	2 (4.00)	48 (96.00)
χ^2-value					9.480
p-value					0.002

4. Discussion

GLP-1, secreted by L cells in the colon and distal small intestine, is a type of incretin hormone. It can bind to GLP-1 receptors widely distributed throughout numerous organs and tissues in the body, thereby achieving physiological effects such as promoting insulin production and release, preventing β-cell death, aiding β-cell growth and regeneration, inhibiting glucagon secretion, reducing food intake, slowing gastric emptying, enhancing glucose uptake and utilization efficiency in peripheral tissues, and decreasing hepatic glucose output [7,8].

Type 2 diabetes mellitus (T2DM), a chronic disease with a high incidence rate, can cause severe damage to patients' nervous, vascular, and ocular systems, among others. Its primary pathological features are driven by chronic hyperglycemia and encompass a core process involving multiple metabolic pathway disorders and intense oxidative stress. As the disease progresses and deteriorates, it can also trigger cardiovascular, cerebrovascular, renal, and other complications, thereby threatening patients' lives [9,10]. The results of this study also indicate that the compliance of the experimental group during the observation period was higher than that of the control group. Analysis reveals that emphasizing the importance of monitoring blood glucose, urine glucose, and other parameters to patients can enhance their awareness of regular blood glucose monitoring. By using visual blood glucose readings to encourage patients to strictly adhere to medical advice and take medications as prescribed, their treatment compliance during the observation period can be improved. The study results show that after treatment, compared to the control group, the levels of fasting plasma glucose (FPG), 2-hour postprandial glucose (2hPG), and glycated hemoglobin (HbA1c) decreased in the experimental group. The reasons for this can be attributed to the fact that, during the treatment of T2DM patients, GLP-1 receptor agonist weekly formulations,

through their multiple pharmacological mechanisms, effectively and safely reduce blood glucose levels comprehensively from both patient compliance and physiological perspectives. Standardized medication management, scientific dietary control, reasonable exercise, and personalized plan adjustments based on continuous monitoring have formed a powerful synergistic effect with the pharmacological actions of GLP-1 receptor agonists, jointly optimizing the body's metabolic environment and ensuring the maximization of drug treatment effects. The decrease in HbA1c is particularly crucial, indicating that not only have short-term blood glucose levels been controlled in patients in the experimental group, but their long-term blood glucose management has also seen substantial improvement. This helps reduce the risk of long-term complications associated with diabetes. The use of "GLP-1 receptor agonist weekly preparations" can more effectively and comprehensively control blood glucose indicators in patients with type 2 diabetes.

GLP-1 receptor agonists promote calcium ion influx into pancreatic β cells and calcium release from the endoplasmic reticulum by activating the cAMP/PKA signaling pathway, thereby enhancing insulin synthesis and secretion in a glucose concentration-dependent manner. When blood glucose levels rise, they significantly stimulate insulin release. These drugs can inhibit glucagon secretion from pancreatic α cells, reducing glucose production. They cease to act when blood glucose levels fall below 4.5 mmol/L, thereby lowering the risk of hypoglycemia. By acting on central appetite regulatory centers and gastric receptors, they suppress appetite, delay gastric emptying, and increase satiety, thereby reducing food intake. They promote glucose uptake by muscle and adipose tissues, inhibit hepatic glucose output, improve insulin sensitivity, stimulate β cell proliferation, and inhibit apoptosis, thereby increasing pancreatic reserve function over the long term. Some drugs have been shown to reduce the risk of atherosclerosis, with mechanisms related to metabolic improvements. High-dose drugs achieve weight loss through central appetite suppression (with some patients experiencing weight loss exceeding 15%), enhancing the insulin-promoting effects of both GLP-1 itself and GIP (another incretin hormone) [11,12]. The results of this study revealed that after treatment, compared with the control group, the treatment group exhibited reductions in abdominal circumference, body mass, and annual hospitalization days, along with a decreased rate of medication discontinuation. Analysis indicated that the once-weekly GLP-1 receptor agonist formulation, due to its simple administration (once a week), resulted in fewer missed doses, slowed gastric emptying, suppressed appetite, and effectively controlled body weight and abdominal circumference. Under the influence of this medication, patients experienced ideal recovery, with a reduction in hospitalization frequency and a corresponding decrease in the rate of medication discontinuation. The study also found that the overall satisfaction rate in the experimental group was higher than that in the control group. Analysis suggested that the once-weekly GLP-1 receptor agonist formulation contributed to promoting patient recovery while enhancing their treatment satisfaction.

In summary, for patients with type 2 diabetes mellitus, treatment with the once-weekly GLP-1 receptor agonist formulation can effectively control blood glucose levels, reduce medication frequency, pose a low risk of hypoglycemia, promote weight loss, decrease hospitalization frequency, and enhance patient satisfaction. This treatment approach is worthy of clinical promotion.

Disclosure statement

The author declares no conflict of interest.

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